ABSTRAK

PENGGUNAAN METODE *PRINCIPAL COMPONENT ANALYSIS* (PCA) BERDASARKAN HASIL UJI TERMOGRAFI PASIF UNTUK IDENTIFIKASI *VOID* PADA BETON

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Void merupakan salah satu cacat internal pada beton yang dapat menurunkan kualitas struktur, sehingga diperlukan metode identifikasi *non-destruktif test* yang akurat. Penelitian ini bertujuan mengidentifikasi luas *artificial void* pada beton menggunakan metode *Principal Component Analysis* (PCA) berbasis termografi pasif serta menganalisis tingkat akurasinya, dan membandingkan peletakan *artificial void* rencana dengan kondisi sebenarnya. Penelitian dilakukan secara eksperimental menggunakan sampel beton dengan variasi kedalaman *void* 0 cm dan 1 cm serta variasi jarak pengambilan citra 0,5 m hingga 2,5 m menggunakan kamera inframerah FLIR E8-XT, kemudian data citra termal dianalisis menggunakan PCA melalui MATLAB. Hasil penelitian menunjukkan metode PCA mampu mendeteksi luas *artificial void* dengan baik pada jarak 0,5 m dan 1 m dengan akurasi rata-rata di atas 99%, sedangkan pada jarak lebih jauh kemampuan deteksi menurun. Selain itu, semakin besar kedalaman *void*, luas *void* yang terdeteksi cenderung berkurang sehingga akurasi menurun. Perbandingan peletakan *void* rencana dan aktual menunjukkan keberhasilan peletakan pada kedalaman 0 cm berada pada kisaran 44–66%, sedangkan pada kedalaman 1 cm di bawah 34%. Berdasarkan hasil tersebut, metode PCA berbasis termografi pasif efektif digunakan untuk identifikasi *void* pada beton, khususnya pada jarak dekat dan kedalaman dangkal.

Kata kunci: Beton, *Void*, Termografi Pasif, *Principal Component Analysis* (PCA), *Non-Destructive Test*.

ABSTRACT

THE APPLICATION OF PRINCIPAL COMPONENT ANALYSIS (PCA) BASED ON PASSIVE THERMOGRAPHY TEST RESULTS FOR VOID IDENTIFICATION IN CONCRETE

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Void is one of the internal defects in concrete that can reduce structural quality, therefore an accurate non-destructive testing method is required for its identification. This study aims to identify the area of artificial voids in concrete using the Principal Component Analysis (PCA) method based on passive thermography and to analyze its accuracy, as well as to compare the planned placement of artificial voids with their actual conditions. This research was conducted experimentally using concrete specimens with void depth variations of 0 cm and 1 cm, and image acquisition distances ranging from 0.5 m to 2.5 m using a FLIR E8-XT infrared camera. The thermal image data were then analyzed using PCA through MATLAB. The results showed that the PCA method was able to detect the area of artificial voids effectively at distances of 0.5 m and 1 m, with an average accuracy above 99%, while detection capability decreased at greater distances. In addition, the greater the void depth, the smaller the detected void area tended to be, resulting in reduced accuracy. Comparison between the planned and actual void placement showed a placement success rate of 44–66% at 0 cm depth, while at 1 cm depth it was below 34%. Based on these results, the PCA method based on passive thermography is effective for void identification in concrete, particularly at close distances and shallow depths.

Keywords: Concrete, Void, Passive Thermography, Principal Component Analysis (PCA), Non-Destructive Testing.